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Cavitation damage can be a costly, recurring problem in many hydroelectric turbines. Detection of damaging cavitation could allow powerplant operators to perform maintenance on a condition-based schedule rather than the more typical time-based scheduling, thus taking a unit out of service only when repair of the damage is justified. Routine repairs to maintain runner bucket profiles are very costly, not to mention the lost power revenues during the down-time. If damage is left unrepaired, efficiency changes can occur, and ultimately, major damage to the rest of the machine is possible.

The detection of cavitation is a fairly easy process because of the noise which is associated with the collapse and implosion of cavitation bubbles. The challenge is to develop techniques for separating the noise and vibration caused by cavitation damage from that caused by non-damaging cavitation and other background noise and vibration sources. A promising approach under development in recent years is based on the observation that when cavitation occurs in a rotating machine, the periodic rotational components will amplitude modulate the wide-band high frequency noise generated by collapsing cavitation bubbles. Modulation may be caused by the periodic rotation of continuous noise sources relative to a fixed sensor or result from periodicity in the hydrodynamics of the flow (e.g., blades passing through wake zones downstream from wicket gates). This amplitude modulation has spurred development of many techniques for cavitation detection, including one that is now commercially available. This approach has some limitations, however, one of which is the technique's inherent ability to detect leading edge cavitation on the runner while not revealing other sources of cavitation damage in the machine. Two additional techniques involving acoustic emission sensors will be tested on a prototype hydroelectric turbine.

The goal of this project is to determine if a new technology can be applied to detecting damaging cavitation in hydraulic machines. If the technology is successful, implementation of the sensor and analysis techniques into a sensor module for use in hydroelectric powerplants would be the final goal. Major objectives along the way to these goals include: procurement of several new "tuned" acoustic emission sensors, installation of the sensors and monitoring equipment at a Reclamation facility (Grand Coulee), and extended monitoring and analysis of data collected from sensors. If successful, the sensor and analysis techniques may be a "module" for use in condition-based monitoring systems.

The initial phase of the project has been completed. Two sensor packages were assembled for testing on a prototype turbine. Data collection and analysis are not quite complete. Initial results have shown a great deal of promise that the cavitation detector could be used in a machine condition monitoring system to provide information for condition-based maintenance.

Personnel at Reclamation's Grand Coulee Powerplant have assisted Technical Service Center personnel in evaluating the cavitation detection instrument packages.

Two instrumentation packages have been developed for testing. Documentation and test results will be written in FY 2000.